datron

OPERATING MANUAL

for

DATRON MODEL 1045/55

DIGITAL VOLTMETER

METEOR CLOSE

NORWICH AIRPORT INDUSTRIAL ESTATE NORWICH NR6 6HQ ENGLAND

OPERATING MANUAL

for

DATRON MODEL 1045/55

DIGITAL VOLTMETER

(FOR CALIBRATION AND MAINTENANCE PROCEDURES,
REFER TO THE SERVICING MANUAL).

Instrument Designed and Manufactured by:-

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SECTION 1

INSTALLATION

1.1 UNPACKING AND INSPECTION

Note:

SHOULD YOUR INSTRUMENT HAVE BEEN SUBJECTED TO EXCESSIVE MISHANDLING IN TRANSIT THE FACT WILL PROBABLY BE VISIBLE AS EXTERNAL DAMAGE TO THE SHIPPING CARTON. UNPACK THE INSTRUMENT AND CHECK FOR EXTERNAL DAMAGE TO CASE, PUSHBUTTONS, TERMINALS, ETC. IF ANY DAMAGE IS FOUND, NOTIFY THE CARRIER IMMEDIATELY.

Every care is taken in the choice of packaging materials to ensure that your new instrument will reach you in a perfect condition. Our packaging and protection are adequate to cater for all the normal hazards of road or rail transit. Special export packaging is provided for overseas orders.

1.2 INSTALLATION

The instrument is housed in a robust, heavy-gauge aluminium case so designed to withstand the rough knocks of industrial usage. The handle pivots are fitted with detent mechanisms enabling the carrying handle to be used as a prop stand giving a variety of viewing angles. A detachable supply lead, comprising two metres of 3-core P.V.C. sheath cable permanently moulded to a fully-shrouded 3-pin cable socket is included. This fits at the rear of the instrument and should be pushed firmly home. Connect the supply lead to a 3-pin plug (fused 1 amp), ensuring that the instrument case is earthed via the Yellow/Green earthing wire.

1.2.1. Voltage Tappings

The instrument is packed ready for use with 205V to 255V, 48 to 440 Hz supplies, unless otherwise specified at the time of ordering. For operation from supplies in the range 105V to 127V, 48 to 440 Hz, it is necessary to alter the connections to the primary windings of the mains transformer. Remove the top cover and note the tags mounted on the printed circuit board adjacent to the mains transformer. For 205V to 255V operation the two primary windings are series connected by linking the 'start' (Red) of one winding to the 'finish' (Brown) of the other. Remove this link and reconnect the two windings in parallel so that the supply is applied across the 'start' and 'finish' of both windings as indicated in Fig. 1.1.

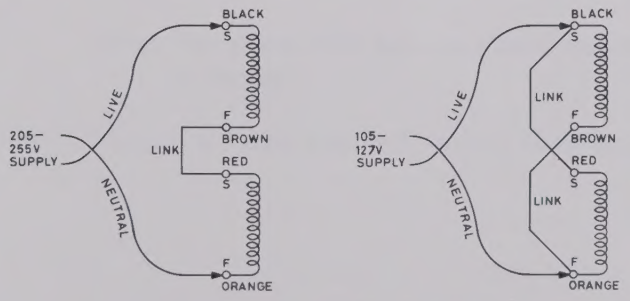

Fig. 1.1

Mains transformer tappings

SECTION 2

GENERAL DESCRIPTION AND SPECIFICATION

2.1 FEATURES

This Digital Voltmeter is a high precision, high stability instrument dedicated to the accurate measurement of DC voltages. It offers the user an economical solution to the problem of precision DC voltage measurement in the 1 microvolt to 1 kilovolt range. Of particular importance is the fully floating input stage capable of swinging through $\pm$ 20 volts and thus maintaining very high input impedance up to these voltages.

2.1.1 Options

A number of optional facilities may be specified at the time of ordering, or in some cases at a later date, to extend the versatility of the Models 1045 and 1055.

AO1 Analogue output gives a 1V DC full range output (2V in overrange) for any full range input.

RO1 Rear input terminals may be specified as an alternative to the normal front-panel terminals.

BO1 (1045 only) Electrically isolated BCD outputs give remote indication of reading in 1-2-4-8 TTL compatible code from a 50-way rear panel mounted connector. External hold, command reading and print command output facilities are provided.

BO2 (1045 only) For added versatility the systems user may require the facility of a 3-state logic BCD output. In effect, this means that a single line on the 50-way connector may be grounded to disable the BCD output completely. This facilitates multiplexing on logic highways by allowing the output lines to be left permanently connected to the system bus-bars without interfering with other peripherals.

FO1 (1045 only) For users requiring higher reading rate capability than the standard 10 per second, the settling time of the input circuitry may be decreased to enable 20 independent readings per second. This slightly degrades the AC Normal Mode rejection.

Note:- The Model 1055 has a maximum read rate of 20 per second as standard.

BO6 (1055 only) A 3-state logic BCD output which functions as BO2.

2.2 ELECTRICAL DESCRIPTION

The instrument comprises a precision, fully floating input isolation amplifier with switched gain ranges which provides a 1 volt full range signal for the analogue-to-digital converter/display section to indicate digitally. Fig. 2.1 illustrates the various sections.

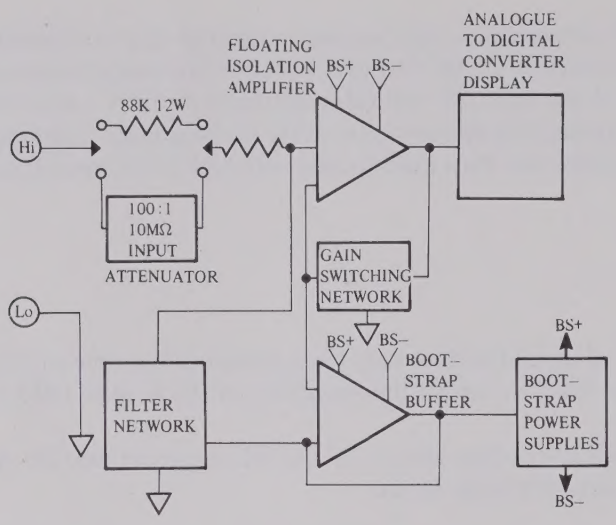

Fig. 2.1 Simplified Block Diagram

2.2.1 Input Attenuator

On the 100 and 1000 volt ranges, the input attenuator divides voltages in the range 20V to 1000V by exactly 100.

2.2.2 Floating Isolation Amplifier

Accurate DC voltage measurement can only be achieved using an instrument of high resolution, which maintains its accuracy by negligible signal loading and by the rejection of errors due to external effects. The floating isolation amplifier performs this task and has excellent DC offset performance (typically 0.2 $\mu V/^{o}C$ and $3pA/^{o}C$). The whole amplifier, including its power supplies follows the input signal, thus providing exceptionally high input impedance (10,000 MΩ) and very good rejection of common mode signals due to its high common mode input impedance.

2.2.3 Boot-strap Buffer

The voltage at the inverting input of the isolation amplifier is detected and buffered to provide a low impedance source which is used as the boot strap voltage. This voltage line is of great importance since it exactly follows the input signal. It is used to drive the floating power supplies BS+ (Boot-strap + 10V) and BS- (Boot-strap – 10V).

2.2.4 Filter Networks

The filter networks combine to provide filtering of unwanted noise voltages whilst maintaining a low settling time. When the FILTER button on the front panel of the instrument is pressed an additional 36dB of rejection at 50 Hz is provided, allowing true measurements in very high noise levels.

2.2.5 Analogue to Digital Conversion

The circuit for converting the analogue signal to digital form was chosen to provide, amongst other things, a high level of noise rejection. To perform accurate low level DC measurements it is necessary to reject both normal and common mode noise voltages. The effect of common mode noise voltages is greatly reduced by using Guard Shield techniques and any remaining normal mode noise is rejected by using a technique similar to the commonly used dual slope integration method of analogue to digital conversion.

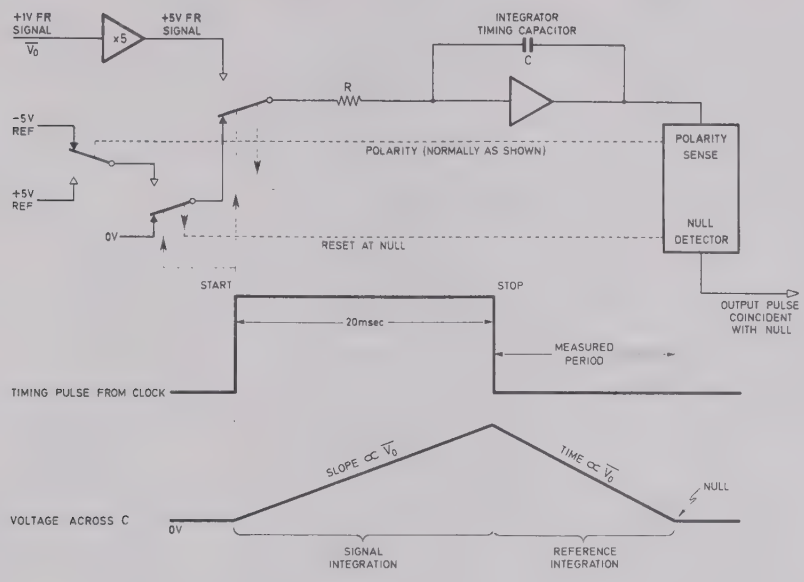

Fig. 2.2.

Fig. 2.2 shows a simplified functional diagram of the converter section. The purpose of this part of the circuit is to convert the input signal Vo into a time-period directly proportional to the input voltage. The 1 volt signal is first amplified to give a 5 volt signal. This is applied via electronic switching, controlled by timing pulses, to resistor R connected to the virtual-earth input of a very high gain integration amplifier. Capacitor C always starts the integration period from a state of zero charge, and now commences to charge up at a rate proportional to the input voltage. The signal integration period lasts for 20msec, during which time capacitor C acquires a charge proportional to Vo.

At the end of 20msec, resistor R is disconnected from the incoming signal and transferred to an accurate 5 volt reference source of opposite polarity to that of the input signal. The length of time it takes to discharge capacitor C to zero volts is directly proportional to the state of charge acquired during the signal integration period which, in turn, is proportional to the input voltage Vo. The instant that the voltage across capacitor C reaches zero is signalled by a pulse from the Null Detector, and fed as a strobe pulse to the display circuitry. The same pulse is used to disconnect the reference voltage, and reset the circuit ready for the start of the next timing pulse.

In the event of capacitor C acquiring a reverse charge during the signal integration period, the Null Detector incorporates a polarity-sensing circuit; this ensures that the reference potential is always of the correct polarity to discharge capacitor C and thus allows measurements of either polarity without reversing the input signal.

2.3 SPECIFICATIONS

2.3.1 General

Power Supply	205 – 255 or 105 – 127 volts, 48 – 440 Hz. Specify line frequency and voltage when ordering. Consumption is approximately 12 VA.
Operating Temperature	0^{o} to 50^{o}C.
Storage Temperature	-25^{o}C to $+70^{o}$C.
Dimensions	H = 90 mm (3.5"), W = 224 mm (8.8"), D = 343 mm (13.5").
Weight	3.5 kg (8 lbs.)
Rack Mounting	"Ears" mounted on side of instrument.
Specification Validity	For 6 months over 18 – 28^{o}C or as described.
Maximum Input Voltage (Without damage)	Signal Hi to Signal Lo 1000V (Any Range) Signal Lo to Guard 250V peak Guard to Earth (Case) 500V peak
Input Resistance (Rin)	10 mV to 10V ranges (up to 20V) Rin >10,000 MΩ 100V and 1,000V ranges Rin = 10 MΩ ± 0.1%
Input Current	<50 pA drifting at typically 3 pA/^{o}C

2.3.2 1045 only

Ranges	10.000 mV, 100.00 mV, 1.0000 V, 10.000 V, 100.00 V, 1000.0 V.
Overrange	100% i.e. 19999 full scale (FS) on all ranges except 1000.0 V.
Accuracy	Six months duration @ 23 ± 5^{o}C after mV offset adjustment. ± 0.01% reading ± 0.005% FS ± 1 μV.
Temperature Coefficient	± One tenth of above accuracy rating/^{o}C ± 0.2 μV/^{o}C.
Stability	After first six months of use better than the above accuracy rating per year plus microvolt offset stability of typically <2 μV per month.
Common Mode Rejection (1 kΩ Source Unbalance)	DC >140 dB AC > 80 dB + SERIES MODE.

Series Mode Rejection	**FILTER OUT**	>20 dB @ 50 Hz increasing at 30 dB per octave + notch rejection
	FILTER IN	>57 dB @ 50 Hz increasing at 18 dB per octave + notch rejection
	NOTCH REJECTION (OPTION FO1)	>50 dB @ line frequency ± 0.15% >36 dB @ line frequency ± 1%
Settling Time (to 0.01%)	**FILTER OUT**	< 78 msec.
	FILTER IN	< 350 msec.
	OPTION FO1	< 5 msec.
Read Rate	Maximum independent reading rate with a nominal full range signal.	
	FILTER OUT	10/sec.
	FILTER IN	2.5/sec.
	OPTION FO1	20/sec.
Analogue Output Accuracy	As normal specifications ± .01% FS.	
Range	0 ± 2 Volts, 1 Volt per nominal Full Range.	
Output Resistance	< 100 Ohms	
Protection	Fuse protected against accidental overload in Output Hi lead.	
BCD Output	**OPTION BO1.** Reading, Range and function, 1-2-4-8 + ve True TTL compatible code. External hold, and read command input facilities are provided together with signal integrate and print command output flags. FAN-OUT 2 TTL LOADS, FAN-IN 1.	
	OPTION BO2. Is as BO1 but with the facility of turning all the outputs into a high impedance condition, and disabling all the inputs.	

2.3.3 1055 only

Ranges	10.0000 mV, 100.000 mV, 1.00000 V, 10.0000 V, 100.000 V, 1000.00 V.
Overrange	100% i.e. 199999 full scale (FS) on all ranges except 1000.00 V.
Accuracy (6 months)	After mV offset adjustment, all ranges. ± 0.005% reading ± 0.0005% FS ± 1 microvolt.

Temperature Coefficient	± 1/10 [of above accuracy rating] /°C ± 0.2 microvolts/°C.	
Stability	After six months use better than 50 ppm per year.	
Short Term Accuracy	As above but .002% reading 24 hrs 22 – 24°C. .004% reading 90 days 18 – 28°C.	
Common Mode	DC >140 dB	
Rejection (1 kΩ Source Unbalance)	AC >80 dB + SERIES MODE up to 180 dB.	
Series Mode Rejection	**FILTER OUT** (100 mV – 1 kV)	>70 dB notch at line frequency and multiples of line frequency.
	FILTER IN (100 mV – 1 kV)	>Above notch + 36 dB at 50 Hz increasing at 40 dB per decade.
	10 mV Range	>Above + 46 dB at 50 Hz increasing at 20 dB per decade.
Settling Time (to .001%)	**FILTER OUT**	< 5 milliseconds
	FILTER IN	< 350 milliseconds
	10 mV range only approx. 10 seconds.	
Read Rate	Maximum independent reading rate with a nominal full range signal.	
	FILTER OUT	20/second
	FILTER IN	2.5/second
Analogue Output Accuracy	As normal specifications ± .01% FS.	
Range	0 ± 2 Volts, 1 Volt per nominal Full Range.	
Output Resistance	<100 Ohms	
Output Current	Up to 5 milliamps.	
Protection	Fuse protected against accidental overload in Output Hi.	
BCD Output	Option BO6 gives reading, range and function 1.2.4.8. +ve true TTL compatible code. External Hold and Read Command facilities are provided together with signal integrate and print command output flags. FAN OUT : 2 TTL LOADS, FAN IN : 1. Provided as standard is the facility of turning all the outputs into a high impedance condition (i.e. "OFF") and disabling all inputs. Option is electrically isolated from the signal input terminals and referred to power ground via a 100 kΩ resistor.	

2.3.4 Specification Verification

A checking routine to ensure that the instrument is working within its specified accuracy is given in Section 6, SPECIFICATION VERIFICATION. The checking procedures given are suitable for incoming inspection purposes, or for use as a periodic check of instrument calibration.

SECTION 3

CONTROLS AND OPERATION

3.1 INPUT CONNECTIONS

Three signal input terminals are located on the front panel marked respectively Hi, Lo and Guard. These terminals may be used as 'binding-posts', or connection may be made using 4 mm banana plugs. The terminals are mounted on standard ¾" spacing between centres, enabling double or triple banana-plug adaptors to be used.

In order to minimise thermal EMF, copper wire should be used for connecting the instrument and preferably passed through the side entry holes of the Hi and Lo terminals.

Note:

The following input voltages must not be exceeded under any circumstances.

Signal Hi to Signal Lo	1000 volts peak.
Signal Lo to Guard	250 volts peak.
Guard to Earth	500 volts peak.

Full details of the recommended methods of making connection between the input terminals and the circuit under test are given in Section 3.3.1.

3.2 CONTROLS

ON/OFF

A push button switch with alternate ON/OFF action is mounted at the left of the display above the input terminals. It isolates the mains supply live from the instrument, with the exception of the mains fuse socket and filter which remain live unless the supply lead is disconnected.

Although no 'Supply On' pilot light is fitted, the circuit is so arranged that when the mains transformer is energized, at least one part of the display will always be glowing, even when no numerals are visible.

RANGE INDICATION

Immediately to the right of the numeric display, two indicator lights are fitted to illuminate one of the following legends:- V or mV.

The legends are necessary in order that the numeric display can be interpreted correctly as being either volts or millivolts.

PUSH BUTTONS

A row of seven push buttons, each clearly marked as to its function, are the only operational controls. Lest there be any confusion regarding these markings, it should be understood that the labelled function or range becomes effective when the button is depressed.

RANGE

The six push buttons at the left of the row are marked:-

1 kV 100 V 10 V 1 V 100 mV 10 mV

corresponding to full-range displays of:-

1000.0(0)V 100.00(0)V 10.000(0)V 1.0000(0)V

100.00(0)mV 10.000(0)mV

Overrange is signified by a 1 being illuminated at the left of the normal display. 100% overrange permits a maximum display of 19999(9) except on the 1 kV range which is 1000.0(0) max.

Overload. Above 100% overrange of 19999(9) the display blanks out (apart from the decimal point) until a less sensitive range is selected.

Note: Numbers in brackets indicates presence on 1055 only.

FILTER

Depressing the FILTER button increases the series mode AC noise rejection and slows down the response time of the analogue circuitry.

mV NULL

This is a screwdriver-operated multi turn preset control to enable the instrument to be adjusted for zero indication with zero input signal applied to the 10mV or 100mV range. Its range is approximately $\pm$ 80 micro volts and it can then be used very effectively to compensate for external offsets as well as the instrument's own very low, long term zero drift.

FUSE

The supply to the mains transformer primary windings is protected by a 100 mA rating 20 mm x 5 mm glass cartridge fuse of the type variously known as 'delay', 'slow-blow', 'time lag' or 'anti-surge'. The fuse may be inspected and, if necessary, replaced by unscrewing the cap of the fuseholder located on the rear panel of the instrument.

Suitable replacement fuses are:-

Belling-Lee. List No. L2080/100
Radiospares. Order Code A/S Fuse 20 mm 100 mA
A.F. Bulgin. Type F286/100 mA

3.3 OPERATION

Preliminary Checks

1. Check that the instrument is correctly adjusted for the mains supply to which it is to be connected. See Section 1.2.1.

Note: No fine tapping adjustments are required for voltages within each of the major ranges.

2. Connect the mains supply leads.

3. Switch on the supply and allow the equipment to stabilize.

4. Before continuing any further, read Section 2, Section 3.1 and 3.2 and in particular the Note in Section 1, page 1.

3.3.1 Common Mode and Guard

Common Mode Voltages are equally present on both terminals of the voltage source being measured and excessive levels, either AC or DC, can affect the measurement being made. However, sensible use of the GUARD terminal can reduce errors to a negligible level.

Note: In most measurement situations it is adequate to strap together the Lo and Guard terminals by use of the link provided and connect the source as shown in Fig. 3.1.

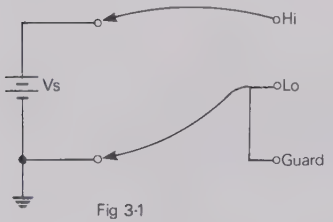

Fig 3-1

The disadvantage of the simple arrangement in Fig. 3.1 is that the connecting leads form a loop. If a stray alternating magnetic field from the mains transformer of a neighbouring instrument passes through the loop it will behave as a single turn secondary winding, and unwanted AC voltages will be induced into the measuring circuit.

The GUARD terminal should be used when the source to be measured presents an unbalanced impedance to the measuring terminals and Common Mode voltages are present. In general, regardless of how the Hi and Lo terminals are connected, the GUARD terminal should refer to the source of Common Mode voltage as shown in Figs. 3.2., 3.3., 3.4. and 3.5.

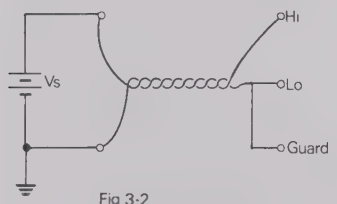

Fig 3-2

Fig. 3.2 is a better arrangement, where the twisted pair reduces the loop area and adjacent twists of the wires produce cancellation of any induced voltages.

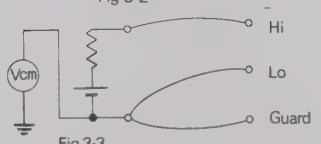

Fig 3-3

The simple case in Fig. 3.3 ALLOWS the GUARD to be connected remotely or at the terminals since in both cases it is to the source of Common Mode Voltages.

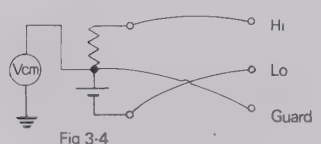

Fig 3-4

Fig. 3.4 shows a case where the Common Mode Voltage is not present on the Lo measurement terminal and should therefore be connected remotely.

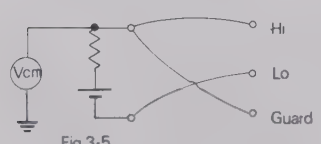

Fig 3-5

Fig. 3.5 shows an extreme situation where all the unbalance to Common Mode Voltage is in the Lo lead and GUARD must therefore be connected to Hi.

The cases above show the connections made by use of individual wires, it is recommended, however, that a screened twisted pair microphone cable be used with the GUARD terminal connected to the screen. Table 3.1 below lists the recommended types.

TABLE 3.1

Manufacture	Type	pF/metre	Outside diameter
Suhner	G03939	65	4.6 mm
Suhner	CB04730	195	5.3 mm
Transradio	MC 02-A	115	4.4 mm
Transradio	MC 02-D	130	3.5 mm
B.I.C.C.	9442Y	120	5.7 mm

When making a particular measurement, choose the most suitable method of connection and check that it does not involve exceeding any of the input voltages listed under Section 2.3.

3.3.2 Thermal e.m.f.

Where very low level measurements are being made, care must be taken to minimise and balance thermal e.m.f. generated in the leads. In general, the use of steel probes, croc-clips and all metals with the exception of copper is to be avoided.

SECTION 4

OPTIONAL REMOTE OPERATION

4.1 OPTION BO1: PARALLEL BCD LOGIC OUTPUT (1045 only)

Option BO1 enables full Binary Coded Decimal outputs describing Reading Range and Function to be obtained from a 50-way Amphenol blue ribbon connector (J5) mounted on the rear panel. The outputs are isolated from the signal input terminals and referred to earth via a 100 kΩ resistor.

Whilst it is recommended that the output digital common be referred to true earth, the input terminals may be floated as high as 500 volts relative to true earth and digital common.

The 50-way connector (J5) also provides various control lines and flags, enabling complete external control of the Analogue to Digital converter. All levels are TTL compatible, with a fan-out of 2.

4.2 OPTION BO2: THREE-STATE LOGIC OUTPUT (1045 only)

Option BO2 is a 3-state (or 'Tri-state'*) version of Option BO1. The basic difference is that upon application of a logic low to pin 42, PRINT INHIBIT, all active BCD and control lines are inhibited. The output lines are forced to a 'third' state which is a very high impedance OFF state.

The instrument can therefore be permanently connected to logic highways or bus-bars in a system and then, by the application of a single logic 0 to pin 42, electrically disconnected at will. Another example would be where the BCD outputs of several instruments are connected in parallel to a printer: a simple single-pole switch could be used to select the outputs from a particular instrument for printing.

4.3 OPTION BO6: THREE-STATE LOGIC OUTPUT (1055 only)

On Option BO6 a 3-state (or 'Tri-state'*) output is standard, and operates as Option BO2 described in Section 4.2.

* Trade Mark : National Semiconductors Inc.

4.4 CONNECTIONS

The following table lists the various functions of the pins on connector J5. BCD output numbers are given magnitudes that assume operation in the 1 V range. Bar notation indicates that a low level (less than 0.4 V) is 'active' or 'enables' the described state.

e.g. $\overline{\text{mV}}$ means that pin 32 is low (less than 0.4 V) when the instrument is operating in either of its two permitted millivolt conditions: 10mV or 100 mV.

Note: Information in brackets indicates present on 1055 only.

J5 Pin No.	Function	Description
1	2×10^{-4}	BCD Output No.
2	4×10^{-4}	" " "
3	8×10^{-4}	" " "
4	1×10^{-4}	" " "
5	2×10^{-3}	" " "
6	4×10^{-3}	" " "
7	8×10^{-3}	" " "
8	1×10^{-3}	" " "
9	2×10^{-2}	" " "
10	4×10^{-2}	" " "
11	8×10^{-2}	" " "
12	1×10^{-2}	" " "
13	2×10^{-1}	" " "
14	4×10^{-1}	" " "
15	8×10^{-1}	" " "
16	1×10^{-1}	" " "
17	OVERLOAD	Indicates signal greater than 19999(9)
18	1×10^{0}	BCD Output No.
19	(2×10^{-5})	(" " ")
20	(4×10^{-5})	(" " ")
21	(8×10^{-5})	(" " ")
22	(1×10^{-5})	(" " ")
23	Not used	
24	Not used	
25	Not used	
26	MINUS POLARITY	0 indicates negative reading
27	PLUS POLARITY	0 indicates positive reading
28	Not used	
29	Not used	
30	Not used	
31	FILTER	0 indicates FILTER: 1 = NORMAL
32	mV	0 indicates mV: 1 indicates Volts
33	Not used	Do not connect
34	DECIMAL POINT 1 (Range A)	0 for BCD MULTIPLIER x 1 (Range Information)
35	DECIMAL POINT 2 (Range B)	0 for BCD MULTIPLIER x 10 (Range Information)
36	DECIMAL POINT 3 (Range C)	0 for BCD MULTIPLIER x 100 (Range Information)
37	DECIMAL POINT 4 (Not used)	0 for BCD MULTIPLIER x 1000
38	Not used	Do not connect
39	Digital COMMON	0 state reference
40	HOLD	Input control line
41	COMMAND	Input control line
42	PRINT INHIBIT	Input control line
43	SIG. INTEGRATE	Output control flag
44	DELAY	Input control line
45	PRINT COMMAND	Output control flag
46	Not used	
47	Not used	
48	Not used	
49	Not used	
50	Not used	

4.4.1 Examples of BCD Coding

Suppose the following pins of J5 are in a 1 state (greater than 2.4 V):-

3 – 5 – 6 – 9 – 12 – 15 – 16 – (20)

this gives a reading of:-

Pins

3	8×10^{-4}	=	.0008
5 & 6	$2 \times 10^{-3} + 4 \times 10^{-3}$	=	.006
9 & 12	$2 \times 10^{-2} + 1 \times 10^{-2}$	=	.03
15 & 16	$8 \times 10^{-1} + 1 \times 10^{-1}$	=	.9
(20)	(4×10^{-5})	=	(.00004)
	TOTAL	=	.9368(4)

This coding of readings is common to 1045 and 1055 models.

1055 Range Coding

The table below shows the state of the RANGE outputs for the six ranges.

Range	Pin 34(A)	Pin 35 (B)	Pin 36 (C)
10mV	1	0	0
100 mV	0	1	0
1 V	1	1	0
10 V	0	0	1
100 V	1	0	1
1,000 V	0	1	1

Now suppose pins 32, 34 and 36 are all in a low or 0 state (less than 0.4 V)
Pin 32 low, indicates that the instrument is measuring mV. Pins 34 and 36 low, with Pin 35 high, indicates a full scale reading of 100.000 mV. The reading is therefore 93.684 mV.

1045 Range Coding

Suppose that, in addition to the BCD coding given in the example, Pins 32 and 35 are both in a low or 0 state (less than 0.4 V)
Pin 32 low indicates that the instrument is in a mV range.
Pin 35 low indicates that the BCD coded reading is to be multiplied by 10.

The reading is therefore
.9368 x 10 millivolts = 9.368 millivolts.

1045 and 1055.

Pin 31 is merely a flag indicating the filter measurement mode, and does not affect interpretation of the BCD number. Pin 17, OVERLOAD, indicates when the input signal is too high for a particular range. BCD numbers may be present even when Pin 17 is in a 1 state but they must not be taken as valid though they will be accurate for numbers only slightly in excess of 19999(9).

4.4.2 Control Lines

Pins 40 to 45 are control lines, enabling the user to control the instrument remotely when it is used in conjunction with other equipment as part of a test system. The control input lines float to a 1 or high state if open circuit, and can be held to a 0 or low state by connecting them to pin 39, digital COMMON.

4.4.3 Print Command

Pin 45, $\overline{\text{PRINT COMMAND}}$ falls from a 1 to 0 state at the end of each measurement cycle, when the new reading has been transferred to the storage registers and is available at the pins of J5 in the form of steady BCD output information.

The falling voltage step available at pin 45 can thus command an external reading device to take note of the BCD output or, alternatively, the 1 state can be used to inhibit scanning of the BCD information. Since the reading is stored, it is available at any time except when new information is being transferred. Pin 45 is only in the 1 state for the duration of the transfer period, lasting about 5 microseconds.

A logic low on pin 42 $\overline{\text{PRINT INHIBIT}}$ prevents the $\overline{\text{PRINT COMMAND}}$ edge from occurring on pin 45, thus making it easy to stop external printers etc. Pin 45 is forced to a low state in this condition.

4.4.4 Signal Integrate

Pin 43 exhibits a high state flag while the analogue to digital converter is acquiring its information. It is made available because its falling edge represents the earliest time at which new signal information may be applied to the input terminals without disturbing the reading in hand. It can thus be used to operate a signal scanner, for example, at the highest possible speed for fully accurate information. The falling edge can also be used to command the instrument, via its delayed command facility, at the same time. See Section 4.4.7.

4.4.5 Hold Reading

Pin 40, $\overline{\text{HOLD}}$, may be externally held in a low state if it is desired to stop the instrument from reaching its normal free-run mode. When pin 40 is taken low the instrument will complete any reading in progress, followed by storing and displaying it until pin 40 is taken high or released, or until an external read command is applied.

4.4.6 Read Command

A falling edge on pin 41, $\overline{\text{COMMAND}}$, instructs the instrument to take one reading immediately if, and only if, pin 40 $\overline{\text{HOLD}}$ is already held low. The instrument inhibits commands that are applied before conversion in progress is complete. Fig. 4.1 shows the relationship of $\overline{\text{COMMAND}}$ and $\overline{\text{PRINT COMMAND}}$ to the integration cycle.

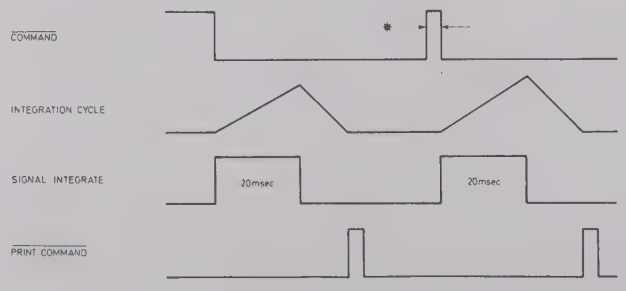

Fig. 4.1

4.4.7 Delayed Command

If pin 44, $\overline{\text{DELAY}}$ is held at logic 0 while an external command is applied, then the command will be automatically delayed by a period of time equal to the settling time of the integration filter. This delay is automatically adjusted depending on whether NORMAL or FILTER is selected by the front panel push button.

Provided pin 44 is held low, this means that the instrument can be commanded at the same instant that new signal information is applied to the front panel terminals. A particularly useful example of this is where the instrument is used in conjunction with a signal scanner, the same command being used for stepping or switching the scanner, as for commanding a reading to be taken, see Fig. 4.2.

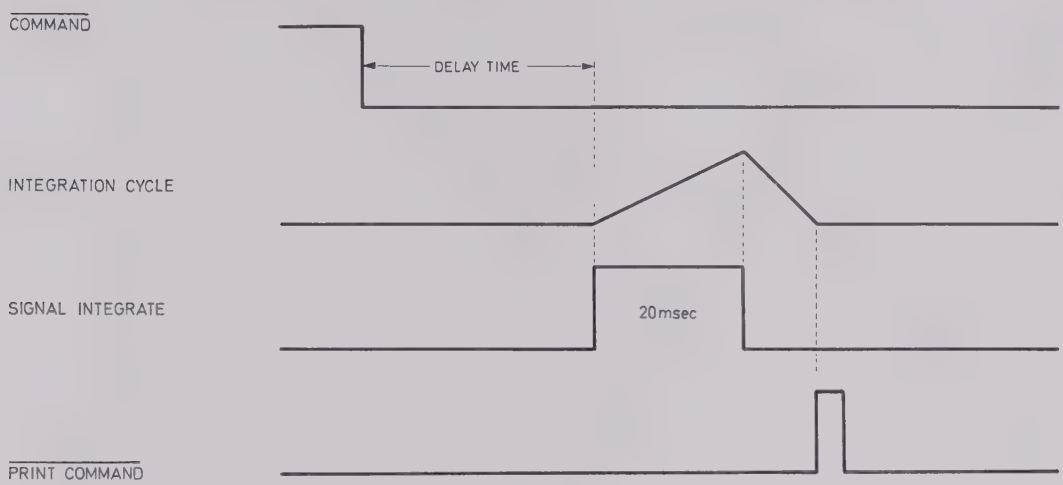

Fig. 4.2

For maximum read rate in a closed-loop system, the command could be the falling edge of pin 43, SIGNAL INTEGRATE, see Fig. 4.3.

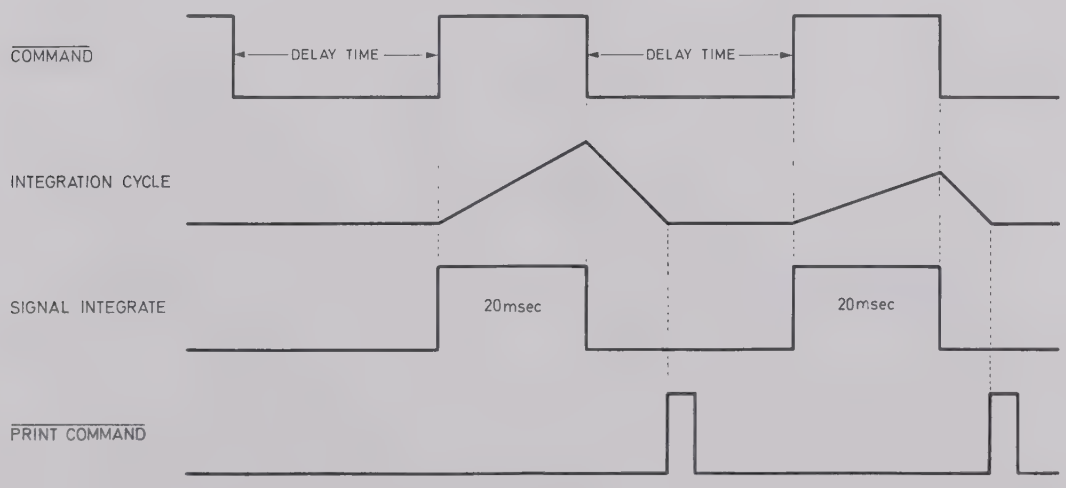

Fig. 4.3

4.4.8 0 State Reference

All digital outputs and command lines are referred to digital COMMON on pin 39. Maximum fan-in is one TTL load, minimum fan-out is 2 TTL loads.

SECTION 5

OTHER OPTIONS

5.1 ANALOGUE OUTPUT

The analogue output is presented from the rear panel via a 5-pin 'M' series connector and a fast-acting fuse in the Hi side. It is a 1 volt full range, output for any nominal full range input, with overrange capability to 2 volts. The output impedance is approximately 100 ohms.

Pin Connections as seen from rear.

A = Output Hi

B = Output Lo

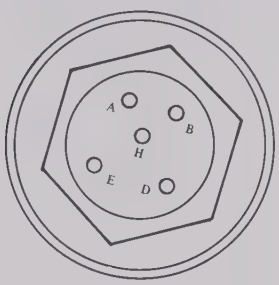

Fig. 5.1

5.2 REAR INPUT

Occasionally it may be more convenient for a user to apply his signal input via the rear rather than the front panel. The spare pins on the analogue output connector can be used for this as follows:-

E = INPUT Hi

D = INPUT Lo

H = GUARD

Note that since high voltage may be present on the input the connector must be wired with great care to prevent shorting or arcing.

If rear input is ordered then the front input terminals are omitted mainly for safety reasons, and a plate bearing the legend "Rear Input Only" mounted on the front panel.

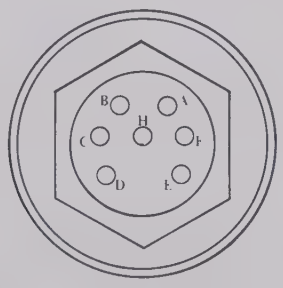

Fig. 5.2

SECTION 6

SPECIFICATION VERIFICATION

6.1 DESCRIPTION

The following steps form a routine for checking that the instrument is working within its specified accuracy where the intention is not to re-calibrate internally. It is thus useful for incoming inspection or routine calibration checks.

It is recommended that due to the wide measurement capability of the instrument, only those aspects of the specification relevant to normal use be verified. This saves considerably in both time and calibration equipment, especially where the 1 μV resolution is not required. For general-purpose measurements, the whole procedure should be followed to verify the entire specification. Space is provided to tick against each step checked.

6.2 INSTRUMENT REQUIREMENTS

A DC source is required of accuracy at least three times better than the accuracy being verified, from 10 mV to 1000 V.

Examples:

Julie Research DVS 106
Fluke source model 332D
with Fluke reference divider model 750A
or other precision 100 : 1 Divider.

6.3 PROCEDURE – DC PERFORMANCE 1045

6.3.1 Turn on the instrument to be checked and allow at least one hour, preferably two hours, to warm up. ☐

6.3.2 Switch instrument to 1 volt range. With the link provided or with wire, connect signal Lo to Guard. ☐

6.3.3 Connect Hi to Lo with a short link. Check the instrument reads 0.0000 $\pm$ 0.0001. ☐

6.3.4 Apply + 1.0000 volts check reading is
+ 1.0000 $\pm$ .0002 ☐

6.3.5 Apply −1.0000 volts check reading is
− 1.0000 $\pm$ .0002 ☐

If 6.3.3. to 6.3.5. are passed this indicates that most of the instrument is working correctly. If it is failed by more than 0.3% then it is likely that there is a fault rather than a calibration error. ☐

6.3.6 Select 10V range — Apply +10.000 V, check reading is
+10.000 $\pm$ .002 ☐

6.3.7 Apply −10.000 V
−10.000 $\pm$ .002 — Check reading is ☐

6.3.8 Select 100 V range
+100.00 $\pm$ .02 V — Apply +100.00 V, check reading is ☐

6.3.9 Apply −100.00 V, check reading is
−100.00 ± .02 V ☐

6.3.10 Select 1 kV range
Apply + 1000.0 V, check reading is
+ 1000.0 ± 0.2 V ☐

6.3.11 Apply −1000.0 V, check reading is
−1000.0 ± 0.2 V ☐

6.3.12 Select 10 mV range. Turn DC source down to zero. Allow several minutes for thermal e.m.f.'s to disappear or stabilize.
Adjust mV offset for display of ± 0.000 ☐

Apply + 10.000 mV, check reading is
+ 10.000 ± 0.003 mV ☐

6.3.13 Apply −10.000 mV, check reading is
−10.000 ± 0.003 mV ☐

(If changing polarity involves reversing leads, check zero again as thermal e.m.f.'s may have changed).

6.3.14 Select 100 mV range Apply +100.00 mV, check reading is
+100.00 ± 0.02 mV ☐

6.3.15 Apply −100.00 mV, check reading is
−100.00 ± 0.02 mV ☐

6.3.16 For linearity check, select 1 volt range.

Apply +0.1000 V, check reading is
+0.1000 V ± 0.0001 V ☐

6.3.17 Apply +0.5000 V, check reading is
+0.5000 ± 0.00015 ☐

6.3.18 Apply +1.0000 V, check reading is
+1.0000 ± .0002 ☐

6.3.19 Apply +1.9000 V, check reading is
+1.9000 ± .0003 ☐

If all the checks given in Section 6.3 are passed, the model 1045 is within its calibration specification.

6.4 PROCEDURE – DC PERFORMANCE 1055

6.4.1 Turn on the instrument to be checked and allow at least one hour, preferably two hours, to warm up. ☐

6.4.2 Switch instrument to 1 volt range. ☐

6.4.3 Connect Hi to Lo with a short link. Check the instrument reads .00000 ± .00001. ☐

6.4.4 Apply +1.00000 V, check reading is
+1.00000 ± .00005 V ☐

6.4.5 Apply −1.00000 V, check reading is
−1.00000 ± .00005 V ☐

If 6.4.3 to 6.4.5 are passed this indicates that most of the instrument is working correctly. If it is failed by more than 0.3% then it is likely that there is a fault rather than a calibration error.

6.4.6 Select 10 V range Apply +10.0000 V, check reading is
+10.0000 ± .0005 V ☐

6.4.7 Apply −10.0000 V, check reading is
−10.0000 ± .0005 V ☐

6.4.8 Select 100 V range Apply +100.000 V, check reading is
+100.000 ± .005 V ☐

6.4.9 Apply −100.000 V, check reading is
−100.000 ± .005 V ☐

6.4.10 Select 1 kV range Apply +1000.00 V, check reading is
+1000.00 ± .05 V ☐

6.4.11 Apply −1000.00 V, check reading is
−1000.00 ± .05 V ☐

6.4.12 Select 10 mV range. Turn DC source down to zero. Allow several minutes for thermal e.m.f.'s to disappear or stabilize.
Adjust mV offset for display of ± 0.0000

Apply +10.0000 mV, check reading is
+10.0000 ± .0015 mV ☐

6.4.13 Apply −10.0000 mV, check reading is
−10.0000 ± .0015 mV
(If changing polarity involves reversing leads, check zero again as thermal e.m.f.'s may have changed. If possible reverse polarity at a higher voltage level so as not to reverse thermals). ☐

6.4.14 Select 100 mV range. Turn DC source down to zero. Allow several minutes for thermal e.m.f.'s to disappear or stablilize.
Adjust mV offset for display of ± 0.000

Apply +100.000 mV, check reading is
+100.000 ± .006 mV ☐

6.4.15 Apply −100.000 mV, check reading is
−100.000 ± .006 mV
(if changing polarity involves reversing leads, check zero again as thermal e.m.f.'s may have changed. If possible, reverse polarity at a higher voltage level so as not to reverse thermals). ☐

This concludes checking of accuracy.

6.4.16 For linearity check, select 1 volt range.

Apply +0.10000 V, check reading is
+0.10000 ± .00001 V ☐

6.4.17 Apply +0.50000 V, check reading is
+0.50000 ± .00003 V ☐

6.4.18 Apply +1.00000 V, check reading is
+1.00000 ± .00005 V ☐

6.4.19 Apply +1.90000 V, check reading is
+1.90000 ± .00009 V ☐

If all the checks given in 6.4 are passed, the model 1055 is within its calibration specification.

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